

Application No: 10/790,383
Amendment dated June 27, 2006
Reply to Office Action Dated March 27, 2006

Attorney Docket No: 3926.070

REMARKS

Claims 6-7 and 10-12 are pending in the application. Claim 6 has been amended. Claims 1-5 have been previously cancelled. Claims 8-9 have now been cancelled.

Claims Rejections – 35 USC § 103

On pages 2-4 of the Office action, claims 6 and 10-12 are rejected under 35 U.S.C. 103(a) as being obvious over Kinsman et al. (US 5,814,784) in view of Baessler et al. (US 5,567,335). Claim 7 is rejected under 35 U.S.C. 103(a) as being obvious over Kinsman et al. and Baessler et al. and further in view of Totsuka et al. (US 5,303,081). Claim 8 is rejected under 35 U.S.C. 103(a) as being obvious over Kinsman et al. and Baessler et al. and further in view of Cutler (US 6,706,998). Claim 9 is rejected under 35 U.S.C. 103(a) as being obvious over Kinsman et al. and Baessler et al. and further in view of Chang et al. (US 4,230,930).

On pages 5-7 of the Office action, claims 6 and 10-12 are rejected under 35 U.S.C. 103(a) as being obvious over Uchiumi (JP 63-43788) in view of Baessler et al. Claim 7 is rejected under 35 U.S.C. 103(a) as being obvious over Uchiumi and Baessler et al. and further in view of Totsuka et al. Claim 8 is rejected under 35 U.S.C. 103(a) as being obvious over Uchiumi and Baessler et al. and further in view of Cutler. Claim 9 is rejected under 35 U.S.C. 103(a) as being obvious over Uchiumi and Baessler et al. and further in view of Chang et al.

First, Applicants would like to briefly review the invention of the instant application.

To meet high quality standards, it is known to thermally treat welding seams. An inductive pre- or post-heating of the weld seam has already been proposed. However, this requires an elaborate additional setup and provides low flexibility with respect to the seam geometry. It has also been proposed to subdivide the energy beam into multiple partial beams using a special mirror and to allow these to run side-by-side over the coated sheets. However, this requires a highly elaborate apparatus and has the disadvantage that the partial beams are

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predefined and fixed with respect to their focal length and position relative to each other. It has further been proposed to use a laser beam initially focused for welding and then retrace the path with the same laser beam over the weld seam but this time defocused in order to "heal" the layer evaporated in the same area. However, this process can only operate when the weld seam is already significantly cooled below the vaporizing temperature of the coating before "healing" irradiation of the weld seam. This process also results in uneven surface warming and allows only a superficial warming of the laser beam facing sheet metal.

The object of the present invention is, therefore, keep the loss in ductility in the seam area as low as possible and at the same time keep the necessary complexity of the apparatus as low as possible and the processing time to a minimum, preferably diminished.

In order to achieve the above object, the present invention provides a process for laser beam welding a plate, comprising

welding a surface of the plate with a laser beam to form a weld seam, and
carrying out a pre- and/or post- thermal treatment in the area of the weld seam with the same laser beam by guiding the laser beam over the surface prior to and/or after the welding,
wherein the laser beam has substantially constant output for both the welding and the thermal treatment.

wherein the welding and the thermal treatment are separated timewise from each other in such a manner that the temperature reduction of the respective radiated surface from the point in time of the first radiation to the point in time of the subsequent radiation is less than 50%, and

wherein during the thermal treatment the laser energy input, based on the radiated surface area and time, is adjusted by increasing the rate of advance in such a manner that the side of the existing or to-be-formed weld seam opposite to the laser beam is warmed by at least 10°C.

The advantages of the present invention include significantly reducing the ductility loss, shortening the processing time, deeper warming the entire weld seam, and requiring only one optical device for laser beam guidance .

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Kinsman et al. disclose a laser processing method using laser radiation for joining, parting, heat treating, or thermally modifying materials, which establishes initial coupling between the laser beam and workpiece by irradiating an intermediate tool that is positioned adjacent the workpiece and is more absorptive at the laser wavelength than the workpiece.

Uchiumi discloses the preheating and welding by a laser beam with the same heating source.

Baessler et al. disclose a process for welding sheet metal edges, in which the edges to be welded are preheated by high-frequency excitation prior to welding.

However, none of the references discloses that the laser beam has substantially constant output for both the welding and the thermal treatment and that the temperature reduction of the respective radiated surface from the point in time of the first radiation to the point in time of the subsequent radiation is less than 50%.

In Kinsman et al. and Baessler et al., the thermal treatment is carried out by irradiating an intermediate tool and by high-frequency excitation, respectively. Therefore, in Kinsman et al. and Baessler et al., the thermal treatment is not carried out by the same laser beam which has substantially constant output for both the welding and the thermal treatment.

The Examiner cited Baessler et al. as disclosing that preheating negates 5 to 40% of the thermal energy required for welding. However, Baessler et al. do not disclose that the temperature at the radiated surface at the time of the first radiation should reduce less than 50% before the subsequent radiation.

In addition, it is noted that claim 6 has been amended to remove the feature that during the thermal treatment the laser energy input is adjusted by defocusing the laser beam. Claim 6 now only recites that during the thermal treatment the laser energy input is adjusted by

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increasing the rate of advance, which is not disclosed by any of the cited references. Claims 8-9 have been cancelled accordingly.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 6. Claim 6 is, therefore, believed to be patentable over the art and since all the dependent claims are dependent on claim 6, they are believed to be patentable as well.

Favorable consideration and early issuance of the Notice of Allowance are respectfully requested. Should further issues remain prior to allowance, the Examiner is respectfully requested to contact the undersigned at the indicated telephone number.

Respectfully submitted,



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